THE

# DENTAL PRACTITIONER

*monthly journal for the Practitioner and his Staff*

VOL. III, NO. 9 MAY, 1953

*Incorporating the Official Supplement of*
**The Dental Laboratories Section of the Surgical Instrument Manufacturers' Association**

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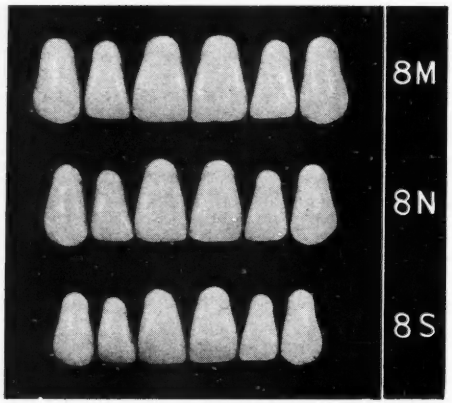


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# THE DENTAL PRACTITIONER

***A Monthly Journal for the Practitioner and his Staff***

*(Incorporating the Proceedings of the British Society of Periodontology and the Official Supplement of the S.I.M.A.—Dental Laboratories Section)*

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Monthly 2s. 6d. post 3d. JOHN WRIGHT & SONS LTD. 42–44 TRIANGLE WEST, BRISTOL 8 Annually 30s. post free

SOLE AGENTS: *Australia*: Robertson & Mullens Ltd., Melbourne; *Canada*: The Macmillan Co. of Canada Ltd., Toronto; *New Zealand*: N. M. Peryer Ltd., Christchurch; *United States of America*: Staples Press Inc., New York; *Denmark*: Einar Munksgaard, Copenhagen; *Norway*: Olaf Norli, Oslo; *Sweden*: Gumperts Aktiebolag, Göteborg; *India*: The Dental Publishing Company, Bombay.

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THE
# DENTAL PRACTITIONER
*A Monthly Journal for the Practitioner and his Staff*

Vol. III, No. 9 May, 1953

*EDITORIAL*

## HANDS ACROSS THE OCEAN

THIS number of the DENTAL PRACTITIONER is dedicated to the University of Pennsylvania School of Dentistry, which on June 10–12 celebrates its diamond jubilee. On behalf of all our readers we offer our congratulations to the Dean, Dr. Lester W. Burket, and all the members of the dental school, past and present. The reputation of Pennsylvania is of the highest order and our best wishes for the future go out to them. The articles in this number have all been written specially by members of their staff and we have to thank them very sincerely for their able contributions. This is possibly the first time that the basic contents of any dental journal have been supplied by distinguished members of the profession of another country, and we are proud to present such a number.

The Seal of the University of Pennsylvania.

A long line of research workers has been produced by this school, and Dr. Appleton in the first article gives an interesting account of the valuable work done over the years in the research departments. Dr. Appleton is well known in this country for his notable book *Bacterial Infection.*

Louis Grossman, the foremost endodontist in the world to-day, contributes an article on recent progress in root canal therapy. His book on root canal therapy must be a "best seller", and many readers will remember the lectures he gave last year on his visit to this country. The radiographic side of root canals is dealt with by Harrison Berry. The Americans still prefer the rather unwieldy word "roentgenogram" to radiograph, the more usual term in this country.

Charles Patton writes on an approach to the problem of the cleft palate, and it is interesting to note that Pennsylvania has a special department with its own professors on cleft palate therapy. The staff conference plan is an excellent idea and brings everyone interested in the problem together in a spirit of co-operation.

Ned Williams gives an account of saliva as a culture medium, and asks some pertinent questions at the end. It is obvious that there is plenty of scope for future research in this subject.

With this first issue of the DENTAL PRACTITIONER by an American Dental School, it is our hope that on future occasions we may bring other articles contributed by American Schools for the benefit of our readers.

# SOME FACETS OF RESEARCH AT PENNSYLVANIA

By **J. L. T. APPLETON**, B.S., D.D.S., Sc.D.
*Dean of the School of Dentistry, University of Pennsylvania*

WHEN asked to write this paper, ambition suggested that, starting with the first catalogue of the dental school, I make a list of all who taught here and then (for the periods of their appointments) that I check for their publications in Black's *Dental Index* and in similar bibliographic records. However, not having time or space for such a meticulous survey, I decided to rely on tradition and personal recollection. In fact, this approach may prove more interesting to my British contemporaries.

The Thomas W. Evans Museum and Dental Institute
THE SCHOOL OF DENTISTRY, UNIVERSITY OF PENNSYLVANIA

It seems reasonable (though generalization is hazardous) that undergraduates seeing their teachers zealous in research, may themselves take to research more naturally. It would be a flattering though hard-to-prove belief that student experiences had something to do with the endeavours of W. D. Miller, who went from our first class to study in Berlin and to apply the then new science of bacteriology systematically to dental problems, or with the endeavours of a later alumnus, Frederick McKay, who justly can be called the father of fluoride research.

In our first faculty Joseph Leidy taught Anatomy: he was one of the last of the great naturalists, who could discover *Trichina spiralis* in his breakfast chop and who could range over the whole field of biology, from the rhizopods of North America to fossil reptiles and mammals. He contributed many facts upon which rest current theories of the mammalian dentition.

James Truman, first dean of this dental school, was a scholarly, kindly man. As editor of the *International Dental Journal*, he was almost automatically made aware of the controversies, and of the resulting studies, which agitated and stimulated the dentists of his day.

Edward C. Kirk, who became dean somewhat later, enjoyed a similar advantage as

The work of another alumnus, Milo Hellman, has received high recognition in the fields of paleontology, odontology, and facial growth. The school, whether justified or not, is willing to accept at least partial credit for the record of its alumni in research.

editor of the *Dental Cosmos*, and made the most of it. He had high intelligence, with a lively mind and wit. His versatility was astonishing. There was a constant stream of young Britishers going through school in those days, from Canada, the British West Indies, England, Ireland, Scotland, South Africa, Australia, New Zealand, and Hong-Kong. Many will remember the hospitality of the old Kirk house in Lansdowne.

During these years he built up a marvellous dental library—the classics of dentistry, the monographs, and full files of its journals, not only in the English language but also in German, Dutch, Danish, Swedish, Norwegian, French, Spanish, and Italian. When the school moved into the building presently occupied, Kirk gave this library to the school. Since then, following his policy, every effort has been made to keep this collection up to date. This is certainly one of the great dental libraries in the world, and an essential tool of all knowing investigators. Following World War II, we were able to distribute many volumes to dental libraries in Europe and in Asia, to make up some of the gaps caused by the destruction and confusion of war: evidence of our desire to further dental research on a world-wide basis.

Philadelphia has long been well supplied with bibliographic resources for scientific study: besides the University Library and its branches there are the great collections of the American Philosophical Society, the Franklin Institute, the College of Physicians, and the Academy of Natural Sciences—all available to students and staff of Pennsylvania.

From now on I'm going to write about dental research at Pennsylvania from my own observations and experience. There is some danger of appearing autobiographical, but that is not my intention: I want merely *to report* some of the things I've heard and seen. I met Kirk first in February, 1908. Adjacent to his office was a small chemical laboratory. Chemistry was his first love: and he kept working away at problems in saliva, in pharmacology and therapeutics, and in the interrelations of diet, nutrition, and metabolism with oral health and disease.

In September, 1909, he introduced me to Alexander Abbott, Director of the School of Hygiene. Abbott (incidentally a brother-in-law of Sir William Osler) was one of the first generation of American bacteriologists. He introduced me to Nathaniel Gildersleeve, who had immediate responsibility for teaching bacteriology to dental students. Through Kirk, Gildersleeve had become interested in the bacteriology of the oral cavity and of oral

Dean Lester W. Burket, B.A., D.D.S., M.D., Sc.D.

disease. Through the next few years we repeated Noguchi's work on the isolation (or rather cultivation) of some of the oral spirochætes. We were also studying bacterial acidogenesis, paying particular attention to the role of the phosphate ion on account of the recently published work of Harden. About this time Kirk became interested in the concept of hydrogen-ion concentration, and arranged for probably the first electrometric determination of the *p*H of saliva. Throughout his life, he repeatedly catalysed research.

In the histologic and embryologic laboratory of W. H. F. Addison, a Canadian, I was put to work on some blocks of dogs' jaws. Matthew Cryer was interested in the foraminal delta of the teeth, so I had my introduction to celloidin

embedding, etc. Cryer, a native of Manchester, England, was Professor of Oral Surgery. He was an indefatigable investigator and is probably best known for his studies on the internal anatomy of the human face. Later, I worked with Addison on various aspects of tooth development, using the standard Wistar strain of the albino rat. The Wistar Institute, a part of the University, was engaged exclusively in biologic research, particularly in studies on growth. Later, I was enabled to use some of Hammett's material in describing a relationship between parathyroidectomy and hypertrophy of the submaxillary gland. There were also genetic studies in progress. Eventually Addison and myself completed a description of the development and growth of the rat incisor teeth, which has been a helpful reference standard in the many experimental studies made in later years in other laboratories. These personal experiences are recounted in order to point out the favourable opportunities and the encouragement which any interested and qualified dental undergraduate would have found at Pennsylvania, even a long generation ago. (The encouragement extended even to a benevolent faculty waiving some of the technique and clinical degree requirements.)

With the money coming from the estate of Thomas W. Evans, Kirk supervised the erection and the equipping of a building, not only for undergraduate teaching of dentistry, but also saw to it that there were facilities for graduate instruction and for research. The available funds were also sufficient to bring to the faculty, on a full-time basis, Arthur Hopewell-Smith (from London), Nathaniel Gildersleeve (mentioned above), and Hermann Prinz: these three men were the then acknowledged leaders in oral histology and pathology, in oral bacteriology, and in oral materia medica and therapeutics. Unfortunately, Gildersleeve lived only a few years after this appointment: but research was in progress constantly in the laboratories of Hopewell-Smith and of Prinz till they retired. Prinz's work included studies on saliva, the formation of salivary calculus, and the conservative treatment of the pulpless tooth. In this latter field Pennsylvania is deeply interested and still remains a leading centre (witness the first World Conference on Endodontics, June, 1953).

One of the older, independent dental schools of Philadelphia, the Pennsylvania College of Dental Surgery, merged with the University of Pennsylvania. When the accounts were settled, there was a balance of about $20,000. This was invested to endow a research fellowship. Over the years this has been most helpful.

For a few years a graduate course in Orthodontics was offered under the direction of A. LeRoy Johnson, who put great emphasis on research.

Thesis requirements for advanced degrees in the Graduate School of Arts and Sciences and in the Graduate School of Medicine have resulted in a number of researches in the field of dentistry. More important is the fact that the programmes of these schools are producing men and women interested in research and better trained to pursue it.

For a number of years the school has offered a biopsy service and a caries-control laboratory to the practising dentist. These activities also furnish opportunities for collateral research. Besides these investigations and the work on the pulpless tooth, already mentioned, I'd also like to call attention to:—

1. The clinical and clinicopathologic studies in oral medicine, constantly in progress.

2. The programme in microbiology which includes a long-term study (*a*) of the kinds and numbers of micro-organisms in the human mouth, and (*b*) of the factors which influence the kinds and numbers, together with the related subjects (*c*) of the interrelations of micro-organisms of the nasal, pharyngeal, and oral cavities, and (*d*) of the oral cavity as a reservoir for or barrier to respiratory and enteric infections.

3. The researches into various aspects of oral histology and oral pathology, including (*a*) the biologic effects of ionizing radiations, and (*b*) neoplasia (both descriptive and experimental).

4. The studies in growth, approached from two distinct, but supplementary, viewpoints, (*a*) that of the experimental embryologist, and (*b*) that of the physical anthropologist. In this latter field the department of orthodontics is

closely affiliated with the Child Growth Centre at the Children's Hospital.

There are many advantages in being an integral part of a large, liberal university which takes most seriously its opportunities and its responsibilities for the communication, preservation, and extension of knowledge. To define "dental" research in terms of what goes on within a particular building or in terms of a particular faculty would be very short-sighted. In this University, in fact in this community, there are many resources, material and human, which can and should be mobilized for the more effective and economical solution of a "dental" problem.

The administration of the dental school and of the University has been most liberal in encouraging the staff to undertake research. In more recent years some recognition from sources outside of the University, and even outside of the profession, seems to justify this policy. The appointments held during the past few years by members of the staff include chairmanship of the Council on Dental Research, and membership on the Council of Dental Therapeutics of the American Dental Association, chairmanship and memberships of the committees, set up by various Federal agencies to review applications for support of dental research, e.g., the Committee of Dentistry, the Committee on Pathology, and the Committee on Physical Anthropology of the National Research Council.

Possibly I've painted too rosy a picture. There's still vast room for improvement, both quantitatively and qualitatively, in dental research at Pennsylvania, and nobody knows it better than I do.

# SALIVA AS A CULTURE MEDIUM

By **NED B. WILLIAMS**, D.D.S., Ph.D.

*Department of Microbiology, School of Dentistry, University of Pennsylvania*

A VARIETY of micro-organisms can be regularly cultivated from samples of human saliva, a fact indicating that the environment in the oral cavity is suitable for their growth and multiplication. In the infant there is a rather simple environment consisting of mucous membranes and the tongue bathed in a film of saliva; yet a complex microbial flora becomes established prior to the eruption of the deciduous teeth. The appearance of the teeth in the oral cavity furnish additional areas for microbial growth, i.e., the tooth surfaces, the gingival sulci, and the interproximal spaces. These regions increase the surface area in the oral cavity and enhance the opportunities for the lodgement, survival, and multiplication of different micro-organisms.

W. D. Miller,[1] in 1890, recognized that nutriment for micro-organisms is available in saliva. It moistens and continuously flows over all oral surfaces; it contains, beside its own constituents, viable and dead bacteria and their products; desquamated and dead tissue cells; and at times dissolved and undissolved food remnants. On the other hand, many workers have reported that saliva and perhaps the micro-organisms suspended in it or their products, have antimicrobial and anti-infectious properties. These may affect the survival of certain organisms gaining entrance into the oral cavity, and thus delimit the regularly cultivable varieties, but such properties do not seem to affect the nutritive value of saliva for the latter organisms.

In view of the foregoing, it is appropriate to ask, "What is the state of our knowledge as to the constituents or contents of saliva that may be conducive to the growth and multiplication of these various micro-organisms?" One approach is to consider the various factors that are known to be important in the formulation and use of an ideal artificial culture medium; then to determine, from recent studies, as to whether these factors are available in saliva as it may exist in its natural environment.

An ideal artificial culture medium, i.e., one that will support the growth of a variety of bacteria, must supply the following:—

1. Moisture, primarily water.
2. Surface tension (air medium) and interfacial tension (micro-organism medium).
3. Proper osmotic pressure.
4. An oxidation-reduction potential.
5. Optimum hydrogen-ion concentration and buffers.
6. Nutritional factors:—
   *a*. Those that are used as a source of energy.
   *b*. Those that are used as "building blocks" for new protoplasm:
      i. A carbon source.
      ii. A nitrogen source.
      iii. Organic compounds that cannot be synthesized and must be supplied.
      iv. Essential inorganic ions.

While the above may well "set the stage" for the growth of an organism, such ingredients are ineffective unless the medium is exposed to a proper incubation temperature, a proper oxygen or carbon-dioxide tension, and sometimes both. The recognition of the above factors and conditions has required long and tedious work by many investigators. How does the saliva in the oral cavity meet these requirements?

**Moisture; Osmotic Pressure; Surface and Interfacial Tensions.**—There is ample moisture in saliva, so this need not be considered further. As far as osmotic pressure is concerned there do not appear to be any direct studies on saliva, or how such pressures in it might affect the cultivation of organisms. It is known that bacteria which have become regulated to high osmotic pressure, like in sea water, temporarily lose viability when exposed to low osmotic pressure and vice versa.[2] It is questionable, however, whether similar sudden shifts in osmotic pressures in saliva can last long enough seriously to affect the organisms.

Surface tension and interfacial tension[3] have a direct bearing on the growth of micro-organisms, but little or nothing has been done with the presence of such factors in saliva, and their effects on micro-organisms.

**Oxidation-reduction Potential.**—The oxidation-reduction potentials of media influence the activities of bacterial cultures. Most media exposed to air have an Eh of between 0·2 and 0·4 volt at *p*H 7·0. Strict anaerobes, on the other hand, require an initial Eh of at least — 0·2 volt. The oxidation-reduction potential of saliva has been studied recently by several workers.[4, 5–8] The Eh values of saliva lie within the range of aerobic artificial culture media. Berg et al.[6] and Turner and Crowell[7] noted that a negative potential in saliva could be attained after incubation aerobically and, as found by Eisenbrandt,[5] the *p*H was in the alkaline range. Apparently, saliva behaves as do other culture media, in that the *p*H value is always inverse to Eh. The growth of anaerobes in the oral cavity, e.g., the fusobacteria and spirochætes, is difficult to explain. It is possible, however, that the reducing power of the aerobic flora, in the presence of slight alkalinity, could permit the growth of anaerobes even though exposed to air. It is necessary in this case that the Eh be near — 0·2 volt.[2] The mechanism by which this could come about is that the rate of production of reduced components by cells overcomes the rate of production of oxidized components by oxygen, but catalase must be present to prevent the accumulation of $H_2O_2$. If this process takes place in the gingival sulcus, it is logical that the rate of diffusion of oxygen might be slow, because of a small surface area. In such an area there is little disturbance (motion), and a reduced salivary viscosity would tend to benefit metabolism. Appleton[8] has suggested a similar hypothesis for the growth of anaerobes in the oral cavity, but indicates that aerobic bacteria could exhaust the oxygen diffusing into the region and also furnish the catalase.

While the information made available by studies on the oxidation-reduction potential of saliva has been of value, it is expected that more information could be obtained if such measurements were made in the mouth, especially in localized areas. Since *p*H must be specified at the time of oxidation-reduction potential measurement, the methods for determining *p*H in restricted areas of the mouth could be used simultaneously.

**Hydrogen-ion Concentration and Buffers.**—The *p*H of saliva has already been discussed but some additions must be made as to its influence on saliva as a culture medium. The values for saliva do not vary over wide ranges[9–11] probably due to the buffer capacity.[12–15] Since these values for the most part are very close to the optima for growth of many organisms, it is unlikely that the *p*H of saliva has much influence on organisms implanted or existing in it, except to affect the *rate* of growth. Bacteria have rather marked potentialities for compensating any large shift in *p*H, because of the suppression or stimulation of specific enzymatic processes[2] by such changes. The salivary *p*H may be lowered temporarily by acid foods[16] (probably a local effect), while enzymatic hydrolysis of urea[17] by bacteria adds to its neutralizing power.

Many workers have studied the *p*H of saliva during its use as a culture medium *in vitro* with or without supplements. Weisberger,[18] incubated saliva without supplement and noted that, along with an increase in *p*H, there was an increase in ammonia plus urea-nitrogen due to deamination. However, in the presence of glucose there was a lowering of the *p*H and no increase in the ammonia plus urea-nitrogen. Cary[19] reported that when urea was added to saliva in the presence of glucose, there was a marked rise in the production of ammonia followed by a rise in *p*H. Ballantyne et al.[20, 21] made a similar observation but without *p*H measurements. Since some workers[6, 18, 22] have reported that glucose, as a supplement in saliva, inhibits ammonia production, it is assumed that the above results are due to enzymatic hydrolysis of the added urea by bacteria, rather than deamination. Cary[19] also noted that when saliva is incubated while spread in a film, the *p*H rises more rapidly and to a higher value than when saliva is incubated in a more restricted area. This seems to suggest that *p*H measurements made on saliva with a low-surface–high-volume ratio, or on collections of saliva within the mouth, are not necessarily true reflections of conditions in the mouth. This may be said for nearly all of the *in vitro* tests on saliva.

Practical use of *p*H and buffer capacity in saliva has been used by many workers[13, 23–25] for estimating relative caries activity by measuring the *p*H or effects of acid production after incubation with glucose, or testing for buffer capacity.

**Nutritional Factors.**—

SOURCE OF ENERGY.—A culture medium must contain carbohydrate, protein, lipid, and certain inorganic ions, so that the organisms can synthesize new protoplasm, if growth and reproduction are desired. Snell[26] has divided the substances that are required, and can be metabolized, into two large groups, and has subdivided the second of these into four groups. The first large group are those compounds used as a source of energy; carbohydrate is the usual substance employed, but is not always the sole source. Saliva may contain glucose[27] or other fermentable carbohydrate after consumption of sweets or food. These substances, along with mucin,[28–30] can serve as sources of energy for bacterial growth. Neuwirth and Summerson[31] studied the oxygen consumption of saliva when it was incubated for 30 minutes with and without glucose. They found that the oxygen consumption in the absence of glucose was very near that found in the presence of glucose, so that energy was obtained only in part from glucose. If lactic acid is present this may be consumed as a source of energy to an extent very close to that of glucose. It was also reported that pyruvic acid is formed from lactic acid, and both of these acids are metabolized, as has also been mentioned by others.[32] Gore[28] found that acid may be produced from mucin, while Rogers[30] studied the breakdown of mucins in saliva by bacteria by measuring the amount of glucosamine produced. This method was employed to eliminate the possible influence of carbohydrates such as starch and glucose on the results. Enzyme inhibitors were found to prevent the breakdown of mucin. It is of interest that this author, as well as Ericsson.[33] has noted a breakdown of salivary blood-group substances, which are polysaccharide in nature.

The respiration rates of whole saliva from different patients vary widely, but seem to be characteristic for the patient contributing the

saliva regardless of time.[34] When carbohydrate is added to salivas having low respiration rates, there is a relatively greater increase in the rates than with salivas which have high initial respiration rates.

"BUILDING BLOCKS" FOR NEW PROTOPLASM.—

*Source of Carbon.*—It should be pointed out that these compounds are not mutually exclusive from those that furnish energy. Some of the substances used to synthesize protoplasm also can be used as an energy source and small parts of the chemical that are used for energy can be used for synthesis. The kinds of organisms existing in the oral cavity require organic carbon for synthesis of new substances. Therefore, substances that are, or may occur, in saliva such as glucose; the protein and polysaccharide moieties of mucin (after breakdown); lactic and pyruvic acids; and amino acids[22, 35–37] may be utilized. Weisberger[18] reported that there is an increase in carboxyl—$CO_2$—when saliva is incubated in the presence of glucose. He selected an analytic method which eliminated all other sources of $CO_2$ except that of amino acids, but he did not simultaneously analyse for amino-acid nitrogen. Thus he showed that proteolysis occurred in this saliva at a low *p*H, indicating that peptidases active at an acid *p*H[38] may be present in bacteria in the oral cavity. Lau et al.[39] and Berg et al.[40] incubated saliva with and without casein and reported an increase in the free carboxyl groups. However, Weisberger[18] reported that deamination exceeded the presence of free carboxyl groups when saliva is incubated without supplements. The obvious discrepancy is probably due to the use of different incubation times.

*Source of Nitrogen.*—The source of nitrogen for bacterial growth is primarily ammonia, derived from nitrogen-containing compounds.[25] Many workers have reported the presence of ammonia or urea nitrogen in saliva.[17, 19–22] Apparently ammonia nitrogen is made available principally as a result of bacterial enzymatic action on saliva. Some organisms, however, cannot synthesize essential substances from ammonia, therefore these must be supplied as amino acids or other substances. The presence of many of the amino acids essential to the growth of the various kinds of organisms in the oral flora have been reported in saliva.[35–37] Clement[29] reported the presence of tyrosine and tryptophane in the protein moiety of mucin, and states that the amino acids in saliva are probably derived from this portion. On the other hand, one cannot discount other available sources of amino acids in saliva, e.g., from foodstuffs, tissue cells, etc. Pincus[4] used saliva as the sole source of nitrogen in a culture medium and noted proteolysis with production of $H_2S$ and indole. Weisberger[41] reported that saliva could not be substituted for tryptophane in a synthetic medium for the growth of a particular lactobacillus strain. However, if saliva was hydrolysed by either acid or alkali the hydrolysates would substitute for either tryptophane or casein hydrolysate, although the alkaline hydrolysate was more suitable.[35] He also reported that if saliva is incubated with glucose over a period of time (up to eight days) the amount of available tryptophane steadily increased and supported growth. On the other hand, this saliva did not contain other available amino acids—its free amino acid N = 0·35 mg., while casein hydrolysate = 3·7 mg. Dreizen et al.[42] reported in a similar study that salivary mucin could not be substituted for tryptophane or casein hydrolysate. However, if trypsin or amylopsin was added along with salivary mucin, substitution would occur. It appears then that hydrolysis of mucin is essential in these studies. Berg et al.[6] noted that tryptophane was degraded almost as fast as it became available in incubated saliva, resulting in an increase in indole. Hill and Kniesner[43] tested salivas for their capacity to support the growth of lactobacilli, especially saliva from mouths that were caries free or caries active. In regard to caries-active saliva, it was found that neither refrigeration nor centrifugation altered its support of growth, but filtration or boiling reduced its suitability as a medium. If caries-free saliva, that which would not support growth, was supplemented with heat-killed bacteria of other types, lactobacilli would then grow in the saliva. This observation remains to be explained.

*Chemical Compounds that must be supplied.*—Organic compounds that cannot be synthesized by an organism and must be *supplied intact* in the medium are termed "growth factors".[26] These substances include amino acids, various vitamins and inorganic ions, etc. The former, in general, are required in greater amounts than the latter two. Kniesner et al.[44] found pantothenic acid in saliva in quantities sufficient to support organisms requiring this vitamin. Weisberger[41] concurred, and also reported that if saliva is concentrated, the presence of $B_1$ (thiamine HCl) and nicotinic acid in quantities that would support growth of a lactobacillus could be detected. Koser and Kaufman[45] found sufficient folic acid in saliva to support the lactic acid bacteria and streptococci that require it. Granados et al.[46] reported $B_{12}$ (thymine or desoxyribosides) in saliva in sufficient amounts to support lactobacilli. The regular isolation of bacteria such as strains of hæmophilus, streptococci, neisseria, etc., suggests the presence of other growth factors, e.g., hæmin, nicotinic acid, pyridoxine HCl, and others. A recent report by Glavind et al.[47] indicates the presence of all of these substances except hæmin.

Little study has been made of the inorganic elements that are required for the growth of organisms. Dreizen et al.[48] report K, Mn, Mg, Cu, and Co ions, but no Ni or Mo. The presence of Co is suggestive of the presence of $B_{12}$—for it is a Co-containing compound. Weisberger[41] reported that saliva could be used to substitute for the inorganic salts $KH_2PO_4$ and $K_2HPO_4$ in a synthetic medium for a lactobacillus.

It is apparent that the constituents of saliva in the oral cavity are closely allied with those factors essential for a good culture medium. It cannot be concluded, however, that all of the constituents have been identified. As stated in the beginning, these constituents are of little value unless incubation temperature and proper oxygen tension and sometimes carbon-dioxide tension are supplied. The temperature of the oral cavity is most suitable for mesophilic bacteria; these include a large group of organisms that are parasitic in man. The growth of organisms requiring either an oxygen or a carbon-dioxide tension in saliva is partial evidence for the presence of these substances, and direct measurements have borne this out.[12]

No mention has been made of the various bacterial enzymes in saliva which may improve it as a culture medium for a variety of organisms, but this aspect has been considered by W. Pigman and A. J. Reid.[49] The role of various foodstuffs in supplementing saliva is widely recognized and is worthy of a separate discussion for which space is not available.

Lastly, the probable existence of synergy and symbiosis between micro-organisms is an important, but little studied, aspect of oral ecology.[8, 32, 51, 52]

Rather than summarizing, it might be worth while briefly to outline certain areas of study, in regard to saliva as a culture medium, which seem indicated from this brief review.

1. Can uncontaminated parotid saliva with or without uncontaminated secretion from other salivary glands support the growth of micro-organisms, and what kind if any? Little or no work has been undertaken on this subject, but there is indirect evidence in the occurrence of post-operative parotitis.[8]

2. Can saliva be treated to inactivate viable bacteria without affecting other constituents (enzymes, etc.)? Since filtration, centrifugation, and heating are likely to alter the composition, some other method should be studied. Preliminary studies indicate that ethylene oxide may be satisfactory for this purpose.[50]

3. Most of the studies in microbiology deal with cultures of single organisms; this rarely occurs in nature. Only a few workers have studied the activities of two or more organisms in the usual culture media.[32, 51, 52] It would be interesting if techniques could be developed to study such activity in uncontaminated saliva and to compare the results with those obtained in other culture media.

4. What are the quantitative interrelationships among various micro-organisms cultivable from human saliva? How do different oral conditions affect such relationships? Preliminary work has indicated differences between patients, dependent, in part, on the time of day.[53]

5. What properties or activities of saliva may be revealed by studying saliva in different surface-volume ratios? How do such results compare? Few workers have attempted this approach,[8, 19] but there is evidence that the properties of other culture media have been found to be quite different under such conditions because the physical fields at the surface of the medium affect the distribution of nutrients as well as organisms.[2]

6. What effect does a high-surface–low-volume ratio of saliva (e.g., a film) have on the selective diffusion of substances? It is conceivable that the nature and concentration of substances in the film could modify diffusion[3] in either direction.

7. What are the activities of micro-organisms on the tooth surface and in the gingival sulcus, under various conditions? Relatively little work[54, 55] has been done on these isolated areas of the oral cavity, perhaps due to technical difficulties.

8. What are the mechanisms by which aerobic and anaerobic micro-organisms are able to survive together in the oral cavity? Hypotheses have been suggested,[8] but no direct evidence is available.

9. It is desirable that more studies on the saliva of experimental animals be made. Many of the uncontrollable factors that complicate studies on human beings might be eliminated.

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# ON THE ROENTGENOGRAPHIC EVALUATION OF ROOT ANATOMY IN ENDODONTICS

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THAT the roentgenogram is an imperative necessity in endodontic practice is a universally established fact. This was realized shortly after the discovery of roentgen rays in 1895, in the days when those radiologic pioneers gained their knowledge from trial and error in day-to-day experience. Prinz, in 1917, very aptly evaluated the role of the roentgenogram in root canal treatment when he said: "An imperative necessity for a correct diagnosis is a roentgenogram of the involved region. It should be understood, however, that the roentgen picture is primarily only an aid to the diagnosis; the basic principle of the latter involves a physical examination in all its aspects."

The literature from that era to the present contains many outstanding reports on the value of the roentgenogram in revealing periapical infections as an indication for root-canal therapy. The necessity for such treatment having once been established, the majority of authors quite correctly mention the need for determining root morphology prior to commencing treatment; few, however, describe in detail any examples of such a study, perhaps feeling it too obvious for any but cursory mention. Enloe, in 1914, recognized that "Lots of perforations would never be made if we would take the trouble to ascertain the direction of the roots before opening them up". Similarly Hergert in 1921 stated emphatically, "To the dentist endeavouring to do root-canal work, the X-ray is a valuable and absolutely indispensable adjunct, and no root canal should ever be entered that has not been previously radiographed to determine the number, length, and direction of the roots." That at least a heartening percentage of contemporary practitioners subscribed to this point of view may be concluded from the results of a questionnaire in 1917 (Waugh) on radiology as an adjunct in "pulp cavity treatment":—

*Question* 4.

(*a*) Do you consider it necessary to radiograph every case?

"Yes" answered by 99. "Some Exceptions" answered by 7. "No", answered by 67. Answer evaded by 19.

(*b*) Do you sometimes find conditions of a physical nature, as malformed or excessively tortuous roots, etc., that make treatment inadvisable?

"Yes", answered by 162. "Rarely". answered by 5. "No", answered by 6. Answer evaded by 19.

(*d*) At what stages of treatment should these be made?

"Before, during, and after treatment", answered by 76. "Start and finish", answered by 50. "When root filling is complete", answered by 11. "Beginning", answered by 7. "Whenever there is a doubt", answered by 7. Answer evaded by 41.

Having established that roentgenographic examination for root canal morphology is indispensable in endodontic practice, this statement must be tempered by including an understanding of the limitations of the roentgenograms. Kells, in 1925, was among the first to publicize its limitations in a paper which described his difficulty in visualizing the third root of a maxillary premolar. The work of Okumura (1927), Skillen (1932), and the classic investigation by Hess (1921) of the minute anatomy of root canals in injected and decalcified teeth pointed up the futility of expecting the roentgenogram to reveal all of their minute ramifications. Bossard (1929) stated that "a high percentage of additional canals branch from the main canal to the periodontal surface of the root. They vary

greatly in size, some being so small that they cannot be seen in radiograms, even when the picture is enlarged". Haskin (1916) stated ". . . and in my studies of radiographs of teeth have found so many canals entirely

*Fig.* 1.—Double 90° curvature in apex of maxillary second premolar; obvious in roentgenogram.

obscured from view, even when taken at various angles and with different time exposures, that I decided to radiograph a number of extracted teeth and study them". The canal ramifications revealed in this study so overwhelmed him that he concluded that not only was the roentgenogram unreliable in the

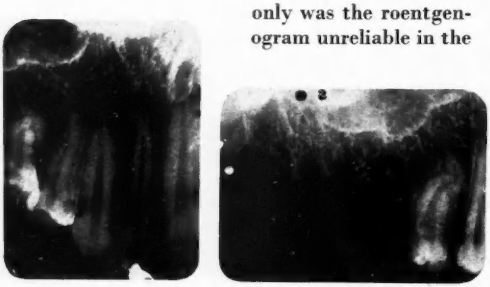


*Fig.* 3.—A, Roentgenogram reveals root canal curvature to mesial, with what appears to be condensing osteitis surrounding apex. B. View from different tube angulation reveals double 90° root curvature for what appeared to be condensing osteitis in A.

visualization of root canals, but he seriously doubted that these multi-canaliculated roots could be successfully treated and filled anyway.

The sensible solution to the problem would seem to be a middle-of-the-road position in which we recognize the roentgenogram as an indispensable aid to diagnosis, realizing and recognizing the limitations necessarily imposed, but exploiting to the fullest our interpretive skill so that we may glean every last bit of information possible from the roentgen images at our disposal. This paper will attempt to analyse two interesting problems in interpretation having a direct bearing upon selection of teeth for endodontic therapy.

*Fig.* 2.—90° distal curvature of mesial root of mandibular third molar.

## ROOT CURVATURE

Appleton (1933) and his co-workers, in "A Report on an Attempt to formulate a Policy on the Management of the Pulpless Tooth", list among some twenty-seven contra-indications for "chemotherapy of the periapical tissues via the root canal" the following:

"1. When access to the periapical tissues via the root canal is mechanically obstructed by curved roots or tortuous canals, secondary dentin, pulp stones which cannot be removed, broken instruments, etc., extract."

Root curvatures to the mesial or distal are usually quite evident and readily visualized (*Figs.* 1–3). The remaining problem in such cases is evaluation of the degree of curvature and width of canal in order to anticipate the ability of the broach to negotiate the curvature. In this regard Grossman (1950) states, "A curvature of about 20 degrees in a narrow root canal may be difficult or even impossible to negotiate, whereas a curvature of even 30 degrees may be negotiated if the canal is wide".

Probably quite as frequently root curvatures to the lingual or buccal exist, but may be recognized less frequently in the roentgenogram owing to the superimposition of the curved portion over the straight portion of the root. This is one of the limitations in X-ray technique imposed by the anatomy of the part. The clue, subtle as it may be, to such a curvature can usually be found in the roentgenogram if a careful examination of

the film is made. This clue is generally a slight increase in radio-opacity of the apical portion of the root, a thin radiolucent line (the image of the periodontal space) encircling this area, and a radiolucent dot (the apical foramen)

*Fig.* 4.—Distal roots of mandibular third molars curving in same plane as X-ray, revealing periodontal space as circle, apical foramen as dot in centre.

generally located near the middle of the circle (*Figs.* 4, 5). Such an image is produced by passage of rays through the same plane as the curved apex (i.e., directly into the apical foramen). Interpretation of such a buccal or lingual curvature is diagnostically significant, for it means (1) that mechanical access to the apical foramen will be difficult if not impossible; (2) that there is a risk of perforation of the root or breakage of the broach; and (3) that root resection or extraction may be the most expedient solution.

*Fig.* 5.—Buccal or lingual curvature of lingual root of maxillary first premolar.

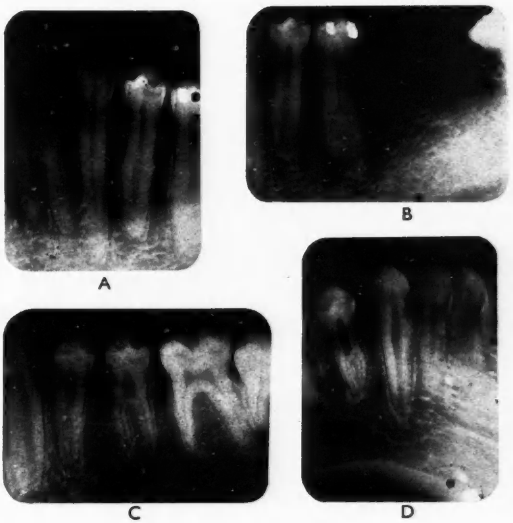


*Fig.* 6.—A, Bifurcation of first premolar root to mesial and distal: radiolucent line below interrupted root canal is actually interradicular bone. B, Second premolar bifurcation to mesial and distal is obvious. C, D, Obvious bifurcations to mesial and distal.

## ROOT AND/OR ROOT CANAL BIFURCATION

Root bifurcations are common and are to be expected in many teeth, notably the maxillary molars and premolars, and mandibular molars. The mandibular first and second premolars and canines often exhibit bifurcation of the root or root canal which frequently poses a somewhat unique problem from an endodontic point of view. In some instances the bifurcation of the canals occurs not at the base of the pulp chamber but in the middle or apical third of the root. If the canals bifurcate to the mesial or distal the roentgenogram usually reveals it adequately (*Fig.* 6). But when canals bifurcate to the buccal and lingual the roentgenogram can only reveal them superimposed over each other; since they

usually are fine canals their images may be faint and not readily visible. Sometimes additional exposures made at different horizontal tube angles may reveal the two separate small canals, but in cases where the image of the pulp canal appears to stop abruptly (*Figs.* 7–11) at the middle or apical third of the root it is usually an indication of bifurcation into two or more smaller canals, rather than calcification of the main canal. The possibility of entering the two canals at this level is much more remote (and often mechanically impossible) than entering canals which bifurcate from the base of the pulp chamber. Hence the majority of such teeth must be recognized as poor risks for root canal therapy from the aspect of mechanical accessibility.

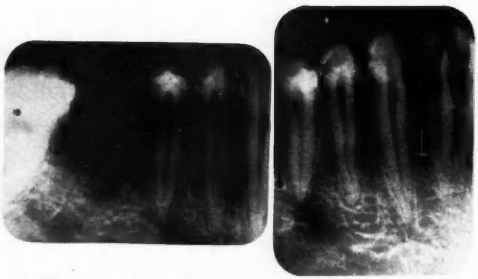

*Fig.* 7.—Bifurcation at apical third of root.

*Fig.* 8.—Bifurcation at middle third of root.

*Fig.* 9.—Bifurcation at middle third of first and second premolars.

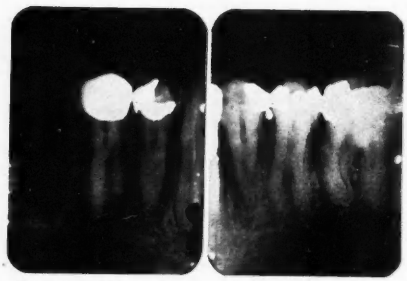

*Fig.* 10.—Bifurcation at middle third of first and second premolars (right and left).



A B

*Fig.* 11.—A, Bifurcation of first premolar root canal at middle third of root. B, Bifurcation of mandibular canine at middle third of root.

## SUMMARY

1. Roentgenograms are an indispensable adjunct to endodontic diagnosis, not only to reveal pathologic processes present but to predict the degree of mechanical accessibility by an evaluation of root anatomy.

2. The anatomy of the parts involved imposes certain limitations in X-ray technique which must be recognized.

3. Recognition of buccal or lingual curvature of root apices is discussed.

4. Recognition of root and/or root canal bifurcation apical to the floor of the pulp chamber is discussed.

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# RECENT PROGRESS IN ENDODONTIC PRACTICE

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OWING to an astute observation of an English physician, more progress has probably been made in the field of endodontics during the last ten years than in its entire previous history. The physician, of course, is Alexander Fleming, and his observation of the lytic effect of a mould upon colonies of *Staph. aureus* led to the development of penicillin. This opportune discovery initiated a chain reaction which has accelerated medical and dental progress, infiltrating into many branches and specialties including endodontics. In fact, I venture to state that no branch of dental practice has escaped the benefits of penicillin, but also, none has been advanced so much by the advent of antibiotics as has endodontic practice. I remember well, about thirty years ago, when I was a dental student, the instructor in charge of the "root canal clinic" prided himself one day because he finally succeeded in securing negative cultures in a refractory case after seventeen treatments. What tenacious persistence, but also, what a wanton waste of time! How economically unsound such practice must have been. Not that this was common practice, but it reflects the difficulty experienced in times past in sterilizing the canals of some pulpless teeth. To-day, with the availability of antibiotics, it is possible to sterilize infected root canals in a minimum of time. With care exercised in the selection of cases for treatment, with a sterile technique, with adequate biomechanical preparation of the root canal, followed by irrigation with a suitably compounded antibiotic combination, it should not take more than one or two treatments to achieve sterility of a previously infected root canal. It will be noted that no emphasis is placed upon antibiotics alone in attaining sterility as they are only one link in the chain of treatment. Each step in treatment is important, and of all the steps, thorough biomechanical preparation is perhaps the most important. Antibiotics are no panacea. One cannot put some potassium penicillin in a root canal and expect it to turn into potassium panacea. There is still no substitute for a sterile technique or for thorough débridement of the root canal. The antibiotics merely lessen the time or number of treatments required to sterilize the canal, but do not obviate the need for good judgement, finger-skill, and perspiration in properly preparing some canals in order that the antibiotics may exert their antibacterial force to the maximum.

What antibiotic or antibiotics shall we employ? It might be well to examine the problem first. Next to adequate débridement and irrigation of the canal, our problem is that of bacterial destruction. What organisms are the antibiotics called upon to destroy? An examination of more than 1000 endodontic cases reveals that Gram-positive organisms (mostly streptococci) were present in more than 75 per cent of cases; Gram-negative organisms (mostly coliform organisms) in less than 10 per cent of cases; and yeast organisms (mostly *C. albicans*) in about 15 per cent of cases.

It might be well to marshall the forces opposing the bacteria, namely antibiotics and other chemicals, and group them in categories depending upon their individual spheres of activity. These are listed in *Table I.*

We have made *in vitro* tests of all the antibiotics set down in the table, and in a number of cases clinical trials were run as well. In view of the fact that no single antibiotic is very effective against all three types of organisms it has been necessary to combine two or more antibiotics, or an antibiotic with some chemical agent, in order to widen the spectrum of antibacterial activity. Our comment, based upon *in vitro* tests and, in some cases, clinical study, follows.

*Table I.*—Antibacterial Agents

| *Gram-positive* | *Gram-negative* | *Yeasts* |
|---|---|---|
| Bacitracin | Dihydrostreptomycin | Actidione |
| Dibenzyl penicillin | Neomycin | Antistine |
| Magnamycin | Polymyxin B | Aspergillic acid |
| Penicillin | Streptomycin | Endomycin |
| Tyrothricin | | Fradicin |
| | | Fungistatin |
| | | Paraben |
| | | Perazil |
| | | Rimocidin |
| | | Sodium caprylate |

| *Gram-positive and Gram-negative* | *Gram-positive, Gram-negative and Yeasts* |
|---|---|
| Aureomycin | Gliotoxin |
| Chloramphenicol | Hexahydrolupulon |
| Terramycin | Humulon |
| | Lupulon |
| | Thiolutin |

*Combinations of Antibiotics*

| *Penicillin* with: | *Terramycin* with: | *Dibenzyl penicillin* with: |
|---|---|---|
| Monochlorphenol | Sodium caprylate | Bradosol |
| Cresatin | Polymyxin B | Cresatin |
| Neomycin | | Polymyxin B |
| Polymyxin B | *Magnamycin* with: | |
| | Polymyxin B | |

## GRAM-POSITIVE ANTIBIOTICS

(For reasons of brevity, the term "Gram-positive antibiotic", etc., is used to denote an antibiotic effective against Gram-positive organisms, etc.)

**Tyrothricin** is a relatively weak antibiotic, effective against Gram-positive organisms only. It is not any more effective than the older root-canal medicaments (Grossman, 1945).

**Bacitracin** is an effective supplement to penicillin, being active against penicillin-resistant organisms such as *Str. fæcalis*, *Str. zymogenes*, *Str. liquefaciens* and against certain strains of staphylococci, which organisms are occasionally present in infected root canals.

**Magnamycin** is one of the newer antibiotics. It has not been found by the author to be as effective against alpha streptococci (the most commonly present micro-organism in root canals of pulpless teeth) as penicillin.

**Penicillin** is still "king" among antibiotics both from the standpoint of effectiveness against Gram-positive organisms and because of its relative atoxicity. Against Gram-positive organisms it has no peer, and is practically non-irritating and non-toxic. Bacterial resistance to it when used in adequate concentration in the root canal has not been observed by the author. Neither has any sensitivity been encountered when the antibiotic has been confined to the root canal. *Dibenzyl penicillin* (dibenzyl ethylene diamine penicillin G) is reasonably stable in aqueous suspension, only 200 units per c.c. going into solution against >100,000 units of potassium penicillin. Dibenzyl penicillin has recently been combined by the author with an effective quaternary ammonium compound in the form of an aqueous suspension, and this gives promise of being a highly satisfactory agent which is effective against the varied micro-organisms present in infected root canals.

## GRAM-NEGATIVE ANTIBIOTICS

**Streptomycin.**—If penicillin is "king" among antibiotics, streptomycin is "queen" among them. Against Gram-negative organisms streptomycin is highly effective. In addition, in combination with penicillin, it is effective against some penicillin-resistant organisms. Either streptomycin calcium chloride complex or dihydrostreptomycin may be used.

**Neomycin** is also very effective against the Gram-negative organisms found in infected root canals. At one time, when neomycin was in a less purified state, the author found that a simple combination of penicillin and neomycin was sufficient to destroy Gram-positive, Gram-negative, and yeast organisms. Later, when neomycin was available in a purified state, it no longer exerted the antifungal effect. It is believed that the crude neomycin contained an antifungal fraction which was "refined" out of the antibiotic upon purification.

**Polymyxin B** is primarily effective against Gram-negative organisms. It is questionable whether it is as effective against the coliform organisms present in root canals as is streptomycin or neomycin.

## ANTIBIOTICS EFFECTIVE AGAINST YEASTS

**Actidione** was not found to be effective against *C. albicans* isolated from root canals.

**Antistine** is an antihistaminic which has been found to be weakly effective against the test organism, *C. albicans*.

**Aspergillic Acid** is highly destructive to yeast organisms, including *C. albicans*.

**Endomycin** was found to have reasonably good antifungal properties, but appeared to be somewhat unstable.

*Fig.* 1.—W. S. Aged 16. Traumatic injury of upper left central 4 years ago. Diagnosis: Chronic abscess. Pre-operative film and check-up film, taken 7 months later, showing almost complete repair.

**Fradicin,** which is derived from *Streptomyces fradiæ*, is a by-product in the production of neomycin. In *in vitro* tests it was found to be one of the most potent agents effective against *C. albicans*.

*Fig.* 2.—V. S. Aged 25. Traumatic injury 11 years previously. Pulp was capped. Tooth became painful to heat and to pressure about two weeks prior to treatment. Diagnosis: Subacute abscess. Pre-operative, post-operative, and check-up film taken 1 year later.

**Fungistatin** was only weakly effective against Candida.

**Paraben** was also found to be only a mildly effective antifungal agent.

**Perazil** was effective in low concentration against Candida.

**Rimocidin,** derived from *S. rimosus* and a by-product in the production of terramycin, is an effective antifungal agent, particularly against *C. albicans*, but is irritating.

**Sodium Caprylate** is quite effective against *C. albicans*, is practically neutral, and almost non-irritating.

## GRAM-POSITIVE AND GRAM-NEGATIVE ANTIBIOTICS

The broad-spectrum antibiotics have only a bacteriostatic effect except in high concentration. By comparison with penicillin and streptomycin, they are weaker antibacterial agents. When a broad-spectrum antibiotic is combined with penicillin, an antagonistic effect is likely to result, depending upon the organism and concentration of antibiotic. On the other hand, when penicillin and streptomycin, or penicillin and bacitracin, are combined, a synergistic effect results.

**Aureomycin** has an acid reaction, or at least is more stable in an acid menstruum, and is likely to be irritating to periapical tissue. In addition, some cases of tooth staining (yellow) have been observed.

**Chloramphenicol (chloromycetin)** is probably the best of the three wide-spectrum antibiotics for local use in the root canal. It will not stain tooth structure.

**Terramycin** is apparently an effective agent when used in infected root canals, but has a tendency to dry out in the root canal and clog it. Terramycin base has been tried with the same undesirable result.

## GRAM-POSITIVE AND GRAM-NEGATIVE ANTIBIOTICS ALSO EFFECTIVE AGAINST YEASTS

There are not many antibiotics which are effective against all three types of organisms. **Humulon, lupulon,** and **hexahydrolupulon** are only weakly effective against these organisms. Furthermore, these antibiotics are extremely unstable. **Gliotoxin** has not been tested very thoroughly by the author, but it appears to be effective and deserves additional study. **Thiolutin** is a by-product in the production of terramycin and is very effective against the organisms tested, but has proved to be too irritating clinically.

## ANTIBIOTIC COMBINATIONS

**Penicillin** has been combined with a variety of other antibiotic or chemical agents with the object of broadening its antibacterial spectrum. Some of the older canal root antiseptics have been tried as a vehicle for penicillin. In no case has this proved satisfactory. For example, penicillin has been added to camphorated *p-monochlorphenol*. The result, after a short time, is a gelatinous, semi-solid mass. Penicillin has also been added to *cresatin*. This combination results in a suspension which is very effective but which is difficult to introduce in the root canal. In time the mass dries out in the bottle even though tightly stoppered. A combination of penicillin and *polymyxin B* in silicone fluid also was found to be unsatisfactory. Penicillin and crude *neomycin* in silicone fluid formed a smooth, reasonably stable paste which was very effective in sterilizing root canals. When neomycin of current commerce is used, an antifungal agent must be added to this combination.

**Terramycin** and *sodium caprylate* was quite effective, and the combination of terramycin base and *polymyxin B* was also very effective, but in a number of cases the root canal became clogged because terramycin has a tendency to cake on drying out.

**Magnamycin** combined with *polymyxin B* in a silicone fluid vehicle was somewhat of

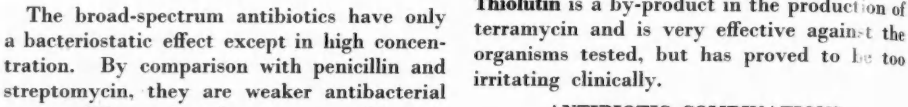

*Fig.* 3.—R. W. Aged 34. No symptoms, but no response during cavity preparation and no reaction to electric pulp test. Diagnosis: Necrosis of pulp. Pre-operative, post-operative, and check-up film taken 2 years later.

(*NOTE.*—All teeth were treated with polyantibiotic paste.)

a disappointment insofar as effectiveness is concerned, as several treatments were necessary before negative cultures were secured.

**Dibenzyl Penicillin** in *cresatin*, and dibenzyl penicillin with *polymyxin B* in silicone fluid have also been tried with reasonably good results. The former exhibited a tendency to become dried out in the container and also to lose potency in time, while the latter combination was not used in a large enough number of cases to determine its effectiveness.

Recently the author has been studying a combination of dibenzyl penicillin and a quaternary ammonium compound—namely, *bradosol*. To date, the study seems to indicate that this combination has encouraging possibilities. It is practically non-irritating on injection into animals, is highly effective when used in infected root canals, is simply prepared, and is stable for a reasonable length of time. Considerably more work will have to be done, however, in order to confirm each of these points. In this combination, penicillin destroys the Gram-positive organisms and bradosol (phenoxy-ethyl-dimethyl-dodecyl ammonium bromide) destroys the Gram-negative and yeast organisms.

Of the many antibiotics and antibiotic combinations examined up to this time, a combination of penicillin, streptomycin, bacitracin, and caprylate sodium (PBSC) as described elsewhere (Grossman, 1951, 1952, a, b) is time-tested and highly effective against all varieties of micro-organisms commonly present in infected root-canals. Until such time as a simpler, but equally effective formula can be developed, PBSC is recommended for the treatment of infected pulpless teeth. In several hundred cases in which this poly-antibiotic paste has been used, the average number of treatments necessary to attain negative cultures was about one and a half. In the majority of cases sterility was obtained after only one treatment. This included canals with putrescent pulps, teeth with acute apical abscess, chronic apical abscess, or granuloma. Of 237 teeth which were checked up by means of X-rays, 221 (93·2 per cent) were successful, 13 (5·5 per cent) were unsuccessful, and 3 (1·3 per cent) were doubtful. Among the unsuccessful cases were a number in which the prognosis was unfavourable *ab initio*. The percentage of successful cases was higher in this antibiotic-treated group than in another group of teeth which had been treated by the older root-canal medicaments. This would tend to indicate that PBSC is not only an effective antibacterial combination, but that it does not interfere with repair of periapical bone.

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# THE LOGICAL APPROACH TO THE CLEFT PALATE PROBLEM

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Cleft palate and cleft lip present one of the most interesting and challenging problems in dentistry and medicine. Individually, the professions could not attain or fully complete the necessary or optimum care in many of these cases. Not so long ago, surgery was performed and the patient was left to society and indifferent professional care (Coursin, 1950). This deformity is as old as man. Down through the ages individual efforts have been made to correct it but little thought of combined planning and co-ordinated effort was considered in dealing with the problem until recently.

In past years babies were rushed from the delivery room to the operating room, because at that time surgery was the only hope. This is easy to understand, as the training of dentists and physicians was widely separated. Now we know that dentistry and medicine can never

actually be separate. Our thinking must be integrated if we are to consider the patient as a whole, and not a patient with a hole in his mouth. Because of the inadequacy of the older concept, those who were interested in the "overall" picture of these unfortunate oral cripples conceived the idea that it was absolutely necessary to have a detailed, intelligent analysis of the patient in order to arrive at a satisfactory diagnosis and treatment.

The Lancaster Cleft Palate Clinic, under the direction of Dr. Herbert K. Cooper, in 1938 inaugurated this philosophy in the United States. Dr. Cooper realized that this problem concerned many specialties, and surrounded himself with the following staff: Plastic Surgeon, Pædiatrician, Oral Surgeon, Psychologist, Speech Therapist, Oto-laryngologist, Audiologist, Dentist, Pedodontist, Orthodontist, and Prosthodontist. This idea has much to recommend it. It has been copied in many clinics all over the country. No one specialty dominates the thinking. Each man contributes his part and it is the *combined* opinions that are brought into play.

Plastic surgery of the palate has its limitations. At times we simply have insufficient tissues to work with and it becomes surgically impossible to get the desired length for proper velo-pharyngeal closure. In other operative cases we get union, but a short palate with a tense band of tissue; this condition makes it very difficult to construct an efficient prosthesis.

Some of the surgical cases have to be reopened (Harkins, 1951) in order to attain a good result prosthetically. Therefore, in the light of our present knowledge, many cases would be better off if left alone surgically. I mention this because I want to emphasize that surgery must be considered as a part of diagnosis. Those who are responsible for the care of the cleft palate must determine when an operation should be performed, how intensive it should be, and then venture a prognosis. The reason for this emphasis on palatal surgery, as the first step in treatment, is that once surgery is done and fails, the damage is permanent. Our recent growth studies by Brodie (1941), Graber (1950), and Krogman (1953), reveal that no palatal surgery should be attempted before the age of four to six years because of the possible injury to the growth centres of the maxilla.

Now let us briefly review the causes, types, and frequency of cleft palate, and some case reports.

The vast majority of congenital deformities of the face can be readily explained along embryological lines (Davis, 1935). In most cases they have resulted from partial or complete failure of union between two or more processes which enter into the formation of the face, thus producing several types and varying degrees of clefts. In other instances union has occurred, but some of the facial processes are malposed or maldeveloped. In occasional cases an embryological explanation of the development is difficult or even impossible to follow satisfactorily. In such cases the malformation may have resulted from abnormalities in the germ cells themselves, or from amniotic conditions producing abnormal pressure, or from the formation of amniotic bands or adhesions.

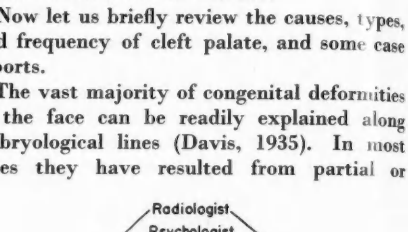


*Fig.* 1.—Diagrammatic plan of co-ordinated treatment. Patient is seen individually by each member of staff, who reports his findings and recommendations at staff conference. In this way a complete treatment plan is set up for each patient.

If for some reason fusion of the several processes does not occur at the critical period in the second month, further growth, stresses, and strains lead to separation of parts, and once a breach in their contiguity is established, union cannot take place subsequently. Lack of fusion, separation, and faulty growth of the several processes lead to malformation and arrests generally listed under cleft palate and cleft lip. The potentialities are such that

several types and degrees of these malformations occur, both unilaterally and bilaterally.

Cleft lip occurs unilaterally and bilaterally, usually unilaterally and more commonly on the left side (Graber, 1949, 1950; Grace, 1943; Harkins, 1951; Krogman, 1953). It results from failure of fusion between nasal and maxillary processes.

Cleft palate is due to failure of fusion between deeper parts of medial nasal and maxillary processes, and, if farther back, of the palatine processes of the maxilla.

A brief study of the early development of the face enables us to visualize more clearly the various types of unilateral or bilateral clefts. Each first branchial arch divides into a maxillary and mandibular process. Superior to the stomodeum, is the frontonasal process, lateral to it the maxillary process, and inferior to it are the mandibular processes. The development of the nasal pits divides the thick frontonasal process into the paired lateral nasal process, from which the medial nasal process or globular processes are differentiated.

The globular process and the lateral process unite, forming the primitive nares and the lateral portion of the upper lip. From the broad median process and the nasal septum, premaxilla and philtrum develop. Palatal ridges appear on the medial sides of maxillary processes from the forty-fifth to forty-eighth day of embryonal life, and, by their approximation, the anterior portion of palate is formed, fusing anteriorly with the premaxillary process and, posterior to this, with each other. Fusion has usually taken place between maxillary and globular processes by the *eighth week*, and between the horizontal portions of the palate bones by the *tenth week*.

The above briefly describes the development of that part of the embryo in which we are interested and mentions how these deformities may occur if anatomic processes are interfered with. We should next consider some of the probable conditions that may give rise or influence the above-mentioned anatomic defects:—

1. *Maternal Impressions.*—This phase has just about been ruled out; histories taken in the majority of cases show that the impressions described occurred after the tenth week of embryonic life.

2. *Malnutrition.*—This has been proved in animal experimentation. Thoma states that tigers, lions, and jaguars in London and Berlin zoos, when fed deficient diets, gave birth to cubs with cleft lip and cleft palate. Correction of diet yielded offspring without such defects.

This has not been proved in humans. Cleft lip and cleft palate is no respecter of families, poor or rich.

3. *Mechanical Influence.*—The horizontal development and union of the palatal processes can occur only after the tongue has moved downward and enlarged the cavity. Failure of the tongue to recede from the nasal cavity before the "closed palate" stage may influence development and cause cleft palate (Schaffer, 1935).

Cryer states, "Lower jaw is formed in advance of upper, while undue pressure by flexion of chin on sternum is exerted on it, it is forced between the four processes forming upper jaw, thus preventing them from uniting".

4. *Rubella or Virus Infections.*—There has not been enough evidence tabulated as yet. Present studies present some evidence that this may have some influence.

5. *Supernumerary* or *Dental Rudiments.*—Presence of supernumerary teeth can cause clefts.

6. *Formation of Amniotic Bands and Pressures* has been advanced as a possible cause.

7. *Heredity.*—Research has shown that this plays a considerable role in transmission of this malformation.

Davis (1935) concluded in his report on 1000 cases that heredity played a most important part in 54 per cent of the cases; probably more if a better history could have been secured.

Schroder reports: Out of 75 cases, 42·7 per cent were inherited; in affected parents 40·5 per cent of children had defect; in unaffected parents, 22 per cent had defect.

Other asymmetrical developments sometimes accompany palatal defects, such as webbed toes and fingers, neurotic tendencies, heart lesions, total congenital deafness, polydactylism, and syndactylism.

For purposes of clarification and simplicity we have adopted the following classification of clefts:—

I. Cleft of soft palate.
II. Cleft of soft palate and hard palate.
III. Cleft of soft palate and hard palate through alveolus. It may be unilateral, right or left. Usually on left side and is frequently associated with cleft lip.
IV. Cleft of soft palate, hard palate, through alveolus on both sides. Bilateral, generally associated with bilateral cleft lip.

Dr. W. M. Krogman, our developmental analyst, has made some interesting studies and I now quote the following:—

At the *Philadelphia Center for Research in Child Growth* (Coursin, 1950) we have studied the growth and development of some 125 children with cleft lip and/or palate, with special reference to cephalofacial growth. In a shorter white series, which we have studied more intensely, we present the incidence as follows (for comparison, an American and a Danish series are included):

| | *Growth Center* | | *U.S. White** | | *Danish*† | |
|---|---|---|---|---|---|---|
| | *No.* | *Per cent* | *No.* | *Per cent* | *No.* | *Per cent* |
| Cleft lip .. | 6 | 10·9 | 133 | 14·2 | 138 | 22·0 |
| Cleft lip and palate .. | 28 | 50·9 | 606 | 64·6 | 360 | 57·7 |
| Cleft palate | 21 | 38·1 | 198 | 21·1 | 127 | 20·3 |
| | 55 | 99·9 | 937 | 99·9 | 625 | 100·0 |

* W. B. Davis (1935). † Fogh-Anderson (1942).

It was found that the male : female occurrence ratio was 2 : 1. The left side, in both lip and palate, was more frequently affected. Unilateral clefts are much more common. In our family histories we found associated congenital anomalies frequently, so that a general and diversely manifested developmental syndrome must be suspected. Our data, based upon seven groups ranked according to nearness of kin, suggest that heredity must be considered as a factor.

In the study of the cephalofacial growth in children at the *Growth Center* we employ measurements of the head and face (ecto-oral cephalometry), X-ray analysis of cephalofacial development (roentgenographic cephalometry), and measurement of the palate (endo-oral palatometry). These three approaches permit of correlative growth analysis with our cleft palate series. In our series the age range was 2 : 3–18 : 0, representing Dental Stages IIA–IVA.

In the cleft palate face the majority of dimensions are below average, indicating lagging growth. Face depths (both endo- and ecto-oral) as a whole are the hardest hit, with mid-face especially vulnerable. Interestingly enough, growth lags generally, for our sample was below the mean in height and weight. Face heights are not markedly affected. The mandible is relatively unaffected, a fact which leads to conjecture as to its genetic independence.

An analysis of our data suggests that maxillary arch length, measured from the posterior surface of M.1 to lingual alveoli of II–I, is established with eruption of M.1. Arch breadth, at level of M.1, is about 90 per cent of its definitive adult value with eruption of that tooth. These averages are from our "normal control" School Series. Hence, we venture to suggest that, on cleft palate cases, any midline surgical procedure leading to bony union will *not* seriously harm postnatal growth potential in the palate after eruption of M.1. *Six years* is thus indicated, but *four years* is permissible, as the optimum time for closure in most cases.

Davis (1935) has reported that clefts are less frequent in Negroes and Hebrews.

Graber (1950), as the result of his studies, comes to the following conclusions:—

1. Cleft palate group as a whole show marked vertical maxillary deformity; this tends to increase with age.

2. Palate which was closed (surgically) at 3 months, shows static maxilla—marking time in downward and forward growth, but with normal mandibular development.

3. Marked growth deficiency in closed palates show a direct correlation with surgical timing and technique: the earlier the operation, the more marked the deficiency; the greater the displacement of tissue, the more deficient maxillary growth; the greater the number of earlier operations, the greater the destruction of growth centres.

As a result of this type of information we are becoming more cautious about surgery at an early age. Surgeons have been slow to accept this, but are now taking these facts into consideration, following dental contributions and research.

*Fig.* 2.—Showing cleft.

## CASE REPORT

R. S., male, white, 18 years of age, came to our diagnostic clinic on March 14, 1951. He had a Class III cleft palate, post-operative lip (left side). The lip had been satisfactorily repaired at an early age; he was the eighth child in a family of sixteen children. To the best of our knowledge there were no other congenital deformities in the family. The father was an alcoholic and tubercular. The patient's hearing was normal; physical condition good; speech typical of cleft palate, but fair considering the loss of palatal tissues. Psychological tests revealed an I.Q. of 62. The general attitude was poor, seemed resigned to his fate. No further surgery was advised because of lack of tissue.

Complete X-rays were taken, including intra-orals, bite-wings, right and left lateral head plates, lateral profile showing hard and soft tissues, and three occlusals. Study models were made, kodachrome pictures, right, left, full face, and intra-oral, were taken.

After his history had been studied, it was decided to refer the patient to the dental Clinic for operative dentistry and prosthesis, this to be followed by speech therapy. The case was then reviewed by the dental staff with the following recommendations: remove lower right impacted third molar, the upper left central and lateral incisors because of the relationship with cleft. Appliance design, made after survey of model, consisted of four cast clasps, palatal coverage of gold, with an acrylic extension and bulb.

Upon completion of the operative work, a tailor-made tray was constructed and a final impression was made for the first stage or palatal coverage. The completed casting, with clasps on the first bicuspids and first molars, was inserted and the patient was directed to wear it for ten days to allow for accommodation.

The second stage (tail piece or velar part) was constructed after taking an impression of the soft tissues. This is done by attaching a piece of base plate of proper length to the palatal portion by means of sticky wax. By adding Adaptol, or similar material, to the base plate a recording of the adjacent soft tissues is obtained. After processing, the appliance is inserted in the mouth and worn long enough for the patient to get used to it without discomfort.

The third and final stage is the construction of the bulb, which should give velo-pharyngeal closure if

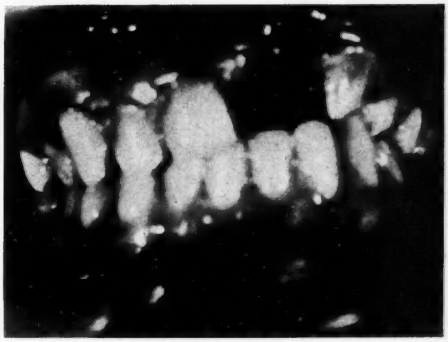

*Fig.* 3.—After extraction of central and lateral incisors.

properly made. A small hole is prepared on the right and left sides of the velar extension, reasonably close to the posterior part. A brass wire (about ·028) is inserted and a loop made extending distally just far enough to miss

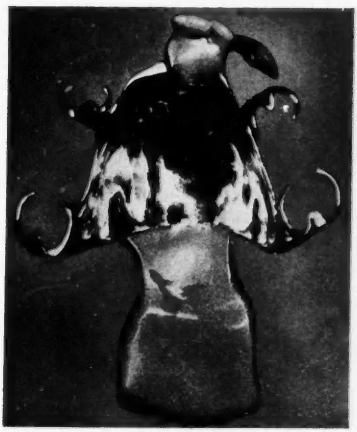

*Fig.* 4.—The appliance.

Passavant's pad.* The location of this loop (in relation of Passavant's pad) is checked by means of a lateral head plate (Cooper, 1950). If correct, we continue. The

* The bulging of the posterior pharyngeal wall produced by the contraction of the overlapping superior and middle constrictors of the pharynx. Usually over atlas bone.

loop is filled with a green inlay wax which serves as a base for the Adaptol which will give the final recording. After this final impression material is added the appliance is immediately inserted in the mouth and the patient is instructed to tilt the head on the chest, turning to the right and then to the left. This will give a proper registration of Passavant's pad. To make doubly sure that we are

*Fig.* 5.—Appliance in position.

*Fig.* 6.—Anterior view of appliance.

in the proper position the bulb impression is covered with tin foil and another lateral plate is taken. If correct, the denture is processed.

We must remember that no speech appliance is ever permanent. There will be a constant change of tissues, as the patient has something to grasp and work on with speech training. We must work with the speech therapist and adjust the appliance as directed. After all, this is the final test.

As the work progressed, we noticed that the sympathetic handling and interest in this boy began to pay dividends. His response was very gratifying. He was appreciative and grateful to think that some one was trying to help him. His whole attitude changed, he seemed to change from an introvert to an extrovert. With speech therapy we look forward to continued improvement. This brings out the fact that was mentioned previously, that while we were doing the necessary dental work, we never lost sight of the patient as a whole and treated him accordingly.

## SUMMARY

1. Cleft lip and cleft palate are the most frequent congenital oral deformities. They occur in 1 out of 770 live births.

2. All cleft palate cases should have the benefit of co-ordinated thinking and the recommendations of a well-rounded staff before anything is done.

3. Plastic surgery is essential for cleft lip and other external deformities. It is not always indicated for cleft palate.

4. Radical palatal surgery should never be done on the palate before four to six years; and not then until consultation with staff members.

5. There is no evidence that the cleft lip or cleft palate child is mentally deficient.

6. Mere construction of a speech appliance with no other considerations is as bad as poorly considered surgery.

7. Dentistry in its several branches is literally indispensable in the treatment of these cases.

8. As a group cleft lip and cleft palate patients suffer from three deficiencies, any one of which would profoundly affect social adjustments. These are mastication, speech, and appearance. It is definitely a catastrophic type of defect. Beginning at birth, the life of the patient may be one record of specialized treatments; lip surgery, palate closure (if indicated by surgery) or prosthesis. As the growth pattern develops, orthodontia, dentistry, and lastly speech therapy are brought into play until ultimate correction has been accomplished.

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# ABSTRACTS
## *from Other Journals*

### Toothbrushing and Massage in Periodontal Disease

This is a monograph in which a series of 54 adult patients with what the author terms "common chronic periodontal disease", which would appear to be an inflammatory lesion of the supporting tissues, were treated by massage of the gingivæ with small wood sticks interdentally in the vestibulo-lingual direction and by brushing with a medium-hard nylon brush, using an up-and-down movement. In all cases one side of the jaw was used as a control, this being on the left in approximately half the cases and on the right in the others.

Before commencing the experiments the patients were rendered as free as possible from calculus on both experimental and control sides.

Observations of pocket depth using a graduated blunt probe, black and white photographs, tendency to bleed, and histology, were made.

The initial clinical observations showed that proximal pockets were deeper on the average than those situated in the interpapillary region, whilst lingual pockets showed a greater mean depth than did the symmetrically located vestibular ones.

After treatment, pocket depth reduction was found to be statistically significant.

The photographic evidence allowed measurement of recession of the proximal gingivæ to be made and this was also statistically significant.

The tendency to bleed was investigated with a specially designed instrument and was again found to be reduced after massage to an extent which proved to be of statistical significance.

No increase in the thickness of the parakeratinized and keratinized layers was demonstrated between the treated and control sides, nor was there any significant decrease in inflammatory cell infiltration of the connective tissue as the result of massage. It was also found impossible to demonstrate any correlation between the degree of stippling of the gingival surfaces and the thickness of the horny layer. No tendency to a higher intensity of keratinization on the treated side was observed.

The author considers, however, that the results of his investigation support the view that massage is a valuable supplement in the therapy of common chronic periodontal disease. —CASTENFELT, T. (1952), *Stockh. nord. Rotogravyr.*

### Tissue Response following Tooth Fracture

A case in which a maxillary lateral incisor was fractured as a result of a blow, but retained for almost two years before extraction, is reported and examined histologically.

Vital connective tissue was found in both fragments, a calcific barrier having been laid down over both ends. In the upper fragment evidence of penetration of vessels and nerves through the calcific barrier, which appeared to be of a cement-like substance, was shown.

A hypothesis is advanced to the effect that an ingrowth of a collateral circulation from the periodontal tissue took place sufficiently rapidly to maintain normal pulp structure and metabolism in the crown fragment.—MANLEY, E. B., and MARSLAND, E. A. (1952), *Brit. dent. J.*, **93**, 201.

### Occlusal Radiography of the Mandibular Third Molar

The writer points out the value to oral surgeons of occlusal views of impacted mandibular third molars and the difficulty in some mouths of obtaining these. The difficulty is due to the position of many wisdoms close to within the ramus of the mandible, the anterior border of which prevents the film from passing farther back over the tooth.

A modification of the technique for taking occlusal radiographs of lower wisdom teeth is described.

The patient's head is laid backwards and rotated to the side opposite to that to be radiographed. A $1\frac{5}{8} \times 1\frac{1}{4}$ in. film packet is

placed across the angle between the vertical ramus of the mandible and the occlusal surfaces of the lower teeth. The posterior edge of the film is inserted between the tuberosity of the maxilla and the ramus and the anterior edge is laid on the cusps of the lower teeth. It is maintained in this position by the patient's finger against the anterior edge of the film packet. The patient should not be permitted to bend the packet with the finger.

The central ray is directed at right angles to the film packet from below and behind the angle of the jaw. (Copying the mesio-distal inclination of the second molar by rotation of the tube about its vertical axis and the bucco-lingual inclination by rotation about the horizontal axis.)

As the mouth is opened the mandibular third molar moves downwards and forwards in relationship to the film packet and its axis moves through an angle. This enables the cone to be centred nearer to the angle of the mandible and the wisdom to be projected forwards onto the film.—DONOVAN, MARGUERITE H. (1952), *Dent. Radiogr.*, **25**, 53.

### The Effect of Alginate Gauze on the Healing of Extraction Wounds

Alginate implants were placed in one or two tooth sockets of twenty-one patients at the time of extraction. At periods ranging from two to thirty-five days afterwards biopsies, which included the buccal tissues and most of the socket contents, were taken of one treated socket, and of one untreated socket from a corresponding area on the other side of the mouth.

The repair processes that occur following extraction were studied and found to confirm the findings of other workers, namely, Mangos, Christopher. The presence of alginates did not adversely affect the general healing processes. In both the treated and control sockets there was an initial downgrowth of epithelium, associated after three days with a marked increase in the size and number of adjacent blood-vessels.

The presence of foreign-body giant cells surrounding the alginate fibres constituted the greatest difference between the treated and the control sockets. The giant cells appeared on the fourteenth day and by the nineteenth day were associated with all the alginate fibres. Traces of the fibrin network of the original blood-clot in the controls and a few fibres of the alginate were still present at the end of the period of study. The tissue reaction to alginate appeared to be that of a relatively non-irritating foreign body.

The bone changes were comparable in the two cases. Osteoclastic resorption was established on the seventh day and reached its maximum activity on the fourteenth day. There was very little resorption of the crest and of the inner surface of the socket, it being mainly confined to the buccal upper third of the bony plate and within the canals.

Bone deposition was well advanced on the fourteenth day along the whole inner surface of the socket. In some sections new bone was also seen on the buccal aspect and above the crest.—SWINBURNE, P. F. (1952), *N. Z. dent. J.*, **48**, 151.

## TAKING ZELEX IMPRESSIONS

When taking a Zelex impression some operators use sticky wax or adhesive tape for attaching the Zelex to the tray. This is a messy business and takes up time. Here is a better method. Obtain a bottle of "Plastic Skin" made by Scott & Bowne Ltd. This has a screw top with a brush attached.

If the tray is made of a base-plate material such as Ash's black tray compound or "Kemdent" base-plate, paint the impression surface of the tray with the plastic skin. Wait a few seconds, then go over the whole of the painted surface with cotton-wool. The fibres of the wool will adhere to the tacky "skin". The Zelex is now placed in position and will be held firmly to the tray by the cotton-wool.

If using an acrylic denture as a tray the same procedure may be followed. If using a metal tray it should first be lined with compo.

If the "skin" cannot be obtained in the bottle form it can be got in tube form. The material in the bottle form is more liquid than that in the tube and much easier to apply.

S. Morris.

# BOOK REVIEWS

**SYMPTOMS AND SIGNS IN CLINICAL MEDICINE.** By E. Noble Chamberlain, M.D., M.Sc., F.R.C.P. Senior Lecturer in Medicine, University of Liverpool, etc., etc. Fifth edition. Pp. 488. 354 illustrations. Bristol: John Wright & Sons Ltd. 35s.

There has always been a tendency to emphasize the surgical aspect of dentistry to the exclusion of medicine. However, with the growing knowledge of modern dentistry, it is imperative nowadays to study the fundamental principles of general medicine to a greater extent. Oral medicine is becoming an entity in itself, and to many a more interesting subject than oral surgery. The modern trend in dentistry is to discover the effect of general disease on the dental tissues, and not, as in the days of focal infection, the effect of dental disease on the general tissues. For the student or the dental practitioner who wishes to learn or re-learn the fundamental principles of clinical medicine there is no better book than Noble Chamberlain's *Symptoms and Signs in Clinical Medicine.* The appeal of this book lies in the fact that it is the symptoms and signs of disease that the dentist must know. It is the recognition of general disease that is important, particularly in diagnosis of certain periodontal diseases and in patients requiring anæsthetics. There is also a wealth of additional information which would repay the dentist who reads this book. The most striking point is the careful and detailed examination of the patient. The routine and mode of inspection in every case would help the dentist in his diagnosis of oral disease.

The book is divided into chapters dealing with each system, with additional chapters on fever, the sick child, and special investigations. The same careful systematic examination is prominent throughout, but there are statements on the examination of the month that are somewhat old-fashioned, to say the least, particularly in a new edition. The word "pyorrhœa" is now considered a lay term, while a case of gingivitis would surely not appear with loose teeth covered with a greenish yellow exudate. It is a pity that actual photographs of Koplik's spots, purpuric spots, and pigmentation could not have been included instead of drawings. As an introduction to clinical medicine it would have been better to give fewer facts (in greater detail) about the appearance of the mouth instead of a lot of facts in a few lines. However, this does not detract from the worth of the book, which is of great practical value to the student and to the dental practitioner.

The book is well produced and amply illustrated, with easy reference, and the price is moderate in these days of high-priced textbooks.

N. L. W.

**DENTISTRY FOR CHILDREN.** By J. C. Brauer, W. W. Demeritt, L. B. Higley, M. Massler, and I. Schour. Third edition. $5\frac{1}{8} \times 9\frac{1}{8}$ in. Pp. 454 + xii, with 263 illustrations. London: Henry Kimpton. 75s.

As in the previous edition, the subject of dentistry for children is dealt with fully and in an easily comprehensible way.

The book is again divided into two parts, Part I dealing with the general approach from which a student or practitioner can gain basic information for making an adequate examination and reasonable diagnosis, while Part II deals generally with technical procedures.

The chapter on preventive orthodontics is well written and its subject matter is presented in a most satisfactory order. If the information it contains is fully appreciated and practice procedures built upon it then undoubtedly many of our patients would benefit most considerably.

The chapter on development of the teeth contains a wealth of information concisely presented, while the section dealing with morphology and histology of the primary teeth is comprehensive but at the same time readable and interesting.

The new feature of this third edition is a chapter by W. W. Demeritt on removable denture prosthesis; this aspect is covered very fully, but the reviewer's personal opinion is that by giving it a separate chapter there is a possibility that too great emphasis has been

placed upon removable space maintainers. This must be regarded, however, as small criticism, because the book as a whole presents the subject-matter, dentistry for children, very ably.

There are few typographical errors and in general the quality of the illustrations is high, minor examples, such as *Fig.* 66(*c*) being inverted, being excepted.

The third edition of the book maintains the high standard one has come to expect from the previous edition and it can be recommended with complete confidence to the graduate and undergraduate alike. A. M. H.

# LETTERS TO THE EDITOR

### Squash Wax Bite *v.* Full Mouth Impressions

*March* 26, 1953.

To the Editor,
Dear Sir,

Your correspondent, R. Williams, in the March issue, commenting on an earlier helpful article by E. A. Schoolden, is rightly anxious that the opposing side of a wax squash bite be cast in plaster first, so as to provide support for the wax, and ensure firm and certain seating of the die.

However, these quickly made squash bites are often deformed by drag during removal from the mouth.

I am fortunate with regular clients, who take full mouth impressions in Zelex for any restoration involving an occlusal surface or proximal contact, but casual prescriptions arrive for porcelain jacket crowns or major gold inlays, accompanied by a squash bite which on casting reveals only about a third of each abutting tooth appearing as if it might be nearly accurate, and sometimes a space of ·020 in. between opposing teeth which ought to be touching.

For most isolated restorations of any kind, a view of the whole mouth is helpful. Full mouth impressions which may be articulated are advisable, and greatly reduce gag-risk in the result.

Yours etc.,

D. Martin Beauchamp.

*Gulliver Road,*
*Sidcup, Kent.*

### Apathy—Why?

*April*, 1953.

To the Editor,
Dear Sir,

I number many dentists among my personal friends, and from time to time have had contact with hundreds, and I have been struck with a very remarkable fact, that there is a desperate tiredness within the profession, for which I have coined a collective noun—A Tiredness of Dentists. Only a dentist can know just how desperately tired, completely drained and exhausted he can become. This tiredness was recognized before the Scheme, but how much graver it is now, after four years of N.H.S. I fell to pondering upon the reason and came to the conclusion that as the old contractual relationship disappeared, leaving the patient to be but an identity number, newer relationships appeared to give a far greater sense of foreboding—the dentist now being in the position of having to satisfy his patient, his executive council, the D.E.B., the M.O.H., the press, parliament, and finally the exchequer. The burden of continuous dentistry was heavy enough before! It has now reached the stage where it is impossible to bear and remain vital.

If this burden is so great and the conditions so impossible that nearly all dentists with a shred of energy left are seeking an escape from dentistry—as I am—what is the future to be? Perhaps the kindest thing that could happen is for us all to recognize the frank absurdity of the state of affairs and to dilute the profession quickly, let dilutees do the work, while we act as underpaid but not overburdened professional administrators.

It must be recognized that the impracticable ideal "that the best should be available to all" creates new demands for professional services at the inevitable costs of dilution and reduced standards all round. Yet the truth of this has not sunk into our socializers and legislators, who are continually looking for fodder to feed into the bureaucratic machine. As a profession we cannot stop this modern trend, and I can only suggest that we speed up the process and having once established a vast bureaucratic machine, which will inevitably grind itself to a standstill and probably bankrupt the country as well, we may rise amid the ashes (of the bureaucrats, I hope) and build anew a classical and glorified profession of private practitioners who may be prepared to operate their own Capitation Plan of Preventive Dentistry at £2 per head per annum—far more effectively and cheaply than ever the bureaucrats dreamed possible.

Yours etc.,

L. A. Philpott.

286, *Hagley Road,*
*Birmingham*, 17.

## I.B.S.T. SILVER TROPHY

A SILVER trophy cup has been presented anonymously to the Dental Section of the Institute of British Surgical Technicians to be awarded annually to the member submitting the best original paper on the subject of dental laboratory techniques, theoretical or practical.

## "SUPPURATIVE OSTEOMYELITIS"

It has been found necessary to hold over the concluding part of the article by Walter C. Allwright, on "Suppurative Osteomyelitis of the Mandible". This part, dealing with Treatment, will appear in our June issue.

OFFICIAL SUPPLEMENT OF THE

# SURGICAL INSTRUMENT MANUFACTURERS' ASSOCIATION (INC.)

DENTAL LABORATORIES SECTION

*Chairman*: E. G. EMMETT, F.I.B.S.T.

*Administrative Offices*: 6, HOLBORN VIADUCT, LONDON, E.C.1

*Telephone*: CITY 6031

Vol. III, No. 2 May, 1953

*Editorial Committee*: D. M. BEAUCHAMP; H. J. POTTER, F.I.B.S.T.

## EDITORIAL

A RECENT information bulletin circulated by the American Dental Association to all its members and to all dental laboratory owners presents a comprehensive statement of the mutual responsibilities and problems of the dental profession and laboratory craft.

Following the specifying of the status of dental laboratories and technicians as an essential adjunct of the profession, but in no sense independent agencies rendering a health service to the public, it surveys the growth of dental laboratories in the United States from one laboratory to eight thousand dentists sixty years ago, to one for every thirteen dentists to-day: the present number of laboratories is estimated at six thousand.

Recent rapid growth is still more remarkable; in 1920 the total value of laboratory services amounted to $18,000,000; to-day it amounts to $150,000,000, or one-seventh of the entire amount expended annually by the U.S. public for dental health care.

Apparently for many years the American Dental Association had urged the craft to develop a unified organization throughout the country, so that mutual problems could be properly explored, and in September, 1951, the two major groups merged to form the National Association of Dental Laboratories, which is founded on the philosophy that the dental profession is the customer, and organized on a pattern similar to that of the A.D.A.

While the illegal practice of dentistry by laboratory and technician is known to exist, no accurate estimates of the extent of such activities are available; the opinion is held that the majority of dental laboratories and technicians are observing the spirit as well as the letter of the law; the culprits haunt the fringe of a highly respected industry and craft.

One of the suggested methods of controlling this bootleg dentistry is the support of the ethical dental laboratories only, by the profession: it is interesting that a similar proposal in England, that the profession should send work only to those whose names appear on the Fair List of Dental Laboratories, was made by the *Dental Technician* as long ago as February, 1949, and repeated in the same journal in an editorial of January this year.

Reverting to the U.S.: since 1946 there has been a voluntary movement by dental societies in individual states to recognize only those laboratories which meet certain requirements and standards.

The A.D.A. opposes registration and licensure of dental laboratories as steps towards controlling illegal practice, as such advocacy seems to indicate that the aim of these measures is dental practice by the technician or laboratory. It must be mentioned here that in the Union of South Africa dental laboratories are compelled to register, keep attendance

records of their employees, and no person may open a dental laboratory until he has satisfied a Governmental committee of his fitness to do so.

The American dentist is asked to see that he does not unwittingly worsen the problems instead of better them: the dentist who sends his patients to the laboratory, or requests laboratory personnel to see a patient; who does not provide complete instructions; who refers a patient to a dental laboratory for any purpose whatsoever; who is unwilling to assume the professional responsibility he has for personally treating a patient; such a dentist contributes to the confusion in profession-craft relations, and to illegal dental practice.

As in the U.S., so in England and the rest of the world, high ideals will bring their reward: the dental laboratory technician should by creating and producing the best work of which he is capable, play his part in raising the general standard of workmanship, and at all times seek to produce only that which will enhance his own prestige and that of the dental profession.

# ANNUAL GENERAL MEETING

## ABRIDGED REPORT

THE Annual General Meeting was held at the Holborn Restaurant, London, W.C.1., on Saturday, Feb. 14, at 10.45 a.m., under the Chairmanship of Mr. E. G. Emmett. The Chairman presented the following items in his report:—

**National Joint Council.** — The following matters have been dealt with on the N.J.C. and much time and consideration has been given to them by the Main Committee:—

**Grading of Dental Technicians.**—This matter has come up for discussion as a result of the revision of the N.J.C. Booklet and the Association has pressed for a more realistic definition of Grades I and II. The general view on our side is that Grade I salary should only be paid to men engaged on Grade I work, but there have been divergent views on the precise terms of the definition. The matter is now one of urgency as the views of the S.I.M.A. are now awaited by the N.J.C. We therefore hope that in the near future we shall have some concrete proposals from the Branches.

**Representation of S.I.M.A. on N.J.C.**—By agreement with the B.D.A. and the trade unions, S.I.M.A. was granted an additional seat on the N.J.C., the B.D.A. consenting to reduce their representation by one, and the Association is now represented on that body by Mr. Sidney Davis and your Chairman.

**Grade III.**—The unions pressed for a rate of £6 2s. 6d. per week for Grade III men, but the Employers' side of the N.J.C. adhered to their decision not to go beyond the £6 which came into operation on Jan. 1, 1952. Entry into Grade III was discontinued as from July 1, 1952.

**Payment during Sickness.**—The Employers' side of the N.J.C. asked for national insurance benefits to be deducted from payment during sickness and the Unions have agreed to this in principle provided the annual half-pay period is extended from four to six weeks. The matter still awaits final agreement on the N.J.C.

**Payment for Holidays.**—The Unions have been seeking an arrangement to cover shorter periods of service than one year on a *pro rata* basis. This matter was to be further considered at the pending N.J.C. meeting.

**The Dentists Bill.**—The Bill has not yet been presented in the House of Commons and we understand that it is now undergoing revision and will be presented at a later date. Preparations were made for further action in the event of the Bill being proceeded with in the autumn, but these proved unnecessary in view of the absence of any developments in connexion with the Bill. A little later information is that, although the Bill is still

being reviewed, the question of its coming up again is delayed still further, but may I assure you that your Committee is watching your interests very carefully at this stage.

**Fixation of Prices.**—Mr. Davis and I discussed this matter on two occasions with Miss Russell Smith of the Ministry of Health, but it was evident that the Ministry was not at present disposed to agree to any fixation of prices for dental laboratories. It was therefore decided to leave the matter in abeyance until a more opportune time.

**Standardization.**—The Dental Section was invited to nominate representatives on Committees which were set up to deal with (*a*) dental tools and laboratory apparatus, and (*b*) acrylic resin materials. Mr. Booth and I undertook to serve on the former and Mr. Beauchamp agreed to represent S.I.M.A. on the latter. One or two meetings have been held but the matter is still in the preliminary stages. Here again I would just say that if any of you have any observations which would be of use to those acting on these Committees would you please make your observations known through Miss Sawers. Many of us are worried about the quality of the materials which are foisted upon us from time to time and now we have an opportunity of putting in our word, and we hope that through our representations we may perhaps persuade the manufacturers to lay down standard techniques and not give us the experimental work on the materials they sell us. We are very grateful to Mr. Booth and Mr. Beauchamp for the work they are doing for us in this connexion which takes up a lot of time when they meet.

**One-day Conference.**—A successful One-day Conference was held at the Holborn Restaurant in July on the occasion of the visit to this country of Mr. R. J. Rothstein, President of the Dental Laboratories Association of the U.S.A. Mr. Rothstein addressed the members at the morning meeting on "Laboratory activities and conditions in the U.S.A.," and was the guest of honour at the luncheon which followed. You will recollect that many of you very kindly gave donations towards a presentation which was made to myself on that occasion, and to those of you to whom I have not had the opportunity of saying this before, I can only say it was very much appreciated, and I feel that in view of the difficult times we were and are still passing through it was more than a noble gesture on your part. It was very much appreciated, and my wife joins me in that appreciation. In the afternoon the Wipla film on Chrome Alloy Casting was shown. These meetings were well attended by members and trade representatives from various parts of the country and overseas. Mr. Booth is to be congratulated on his successful organization of the programme for the day.

**Visit of Representatives of the Fédération Nationale de la Prothèse Dentaire.**—In September, through the good offices of Mr. D. M. Beauchamp, we had the pleasure of meeting representatives of the French Laboratories Organization at the Holborn Restaurant when a useful exchange of information and ideas took place. An invitation was subsequently extended to S.I.M.A. to send a representative to an International Conference of Dental Laboratories in Paris (May 16, 17), and Mr. Beauchamp has undertaken to attend this on our behalf.

**Demonstration of "Swedon".**—In collaboration with Messrs. Henry Courtin & Sons a demonstration of Swedon, the cold-curing acrylic, was arranged at the Eastman Dental Hospital on January 22, and Messrs. Cottrell & Co. also co-operated with a demonstration of the Dentatus Articulator. This meeting was well supported by London members and trade representatives and it has been suggested to Messrs. Henry Courtin that the Branches might also wish to have a similar demonstration in their areas for the benefit of local members.

**Dental Practitioner Supplement.**—The DENTAL PRACTITIONER Supplement has been published each month and we are greatly indebted to Mr. Beauchamp and Mr. Potter for their services as editors. This has been extremely arduous and they have been hampered by lack of material for publication, which it was anticipated would be furnished by members.

**Appointment of Paid Representative for Dental Section.**—In view of the difficulty of finding members who can spare the time to

represent S.I.M.A. at the many meetings and conferences in which it is very desirable we should participate, a sub-committee considered the possibility of appointing a paid representative. It became clear that the Association would have to depend upon members to attend these meetings and it was suggested that they should be reimbursed to some extent for their loss of time.

**Resignation of Mr. Grant and Mr. Lucas.**—During the year Mr. Grant felt obliged to tender his resignation from Vice-Chairmanship and membership of the Main Committee and this was accepted with much regret and with appreciation of his long and willing service. We hope in the near future to be able to make some tangible recognition of his efforts on behalf of the Association.

Mr. H. F. Lucas also had to tender his resignation as the representative of our Section on the Council of Management of S.I.M.A., and here again we would like to record our thanks and appreciation for the assistance he has at all times been ready to give, Mr. Nowers has kindly undertaken the duty of representation on the Council of Management and is now the representative of the London Regional Branch on the Main Committee.

**Educational Information.**—On educational matters one could tell quite a story, but I must deal with that briefly as time is rather against us and most of you are aware of what we are still doing. I would just say that our interests and those of the Craft are still being looked after by our representatives on the National Joint Council Education Advisory Committee as well as on the local advisory committees on which a number of our members serve and also act as examiners for the London City and Guilds Institute examinations while others are acting as instructors at the various technical colleges and institutes.

**Election of Committee.**—The following members were elected to serve on the committee for the ensuing year: Mr. E. G. Emmett, Mr. G. Cross, Mr. F. E. Martin, Mr. H. J. Potter.

In conclusion the Chairman thanked the members for their attendance and particularly those who had travelled long distances.

This concluded the business and about fifty members lunched together in the Restaurant.

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## THE LONDON REGIONAL BRANCH TABLE AT THE HOLBORN RESTAURANT

THE recent exhibition of dental workmanship and hobbies gave members the opportunity to display their versatility in handicrafts of much variety, from embroidery to pottery. The table show of the London Regional branch was in the charge of the chairman, Mr. Frank E. Martin, and Mrs. Martin assisted him by tastefully arranging over a hundred specimens to great advantage.

Several items of jewellery were the work of Mr. Martin, a gold set cameo bracelet, gold and silver charm bracelets, and rings: E. R. Macro showed a cast-gold bracelet having an ivy-leaf motif. The centre showcase contained the magnificent silversmithing of T. E. Crawt, a solid silver hand-wrought tea-set, three trays, a coffee set, bracelets, and rings. Choice wood carving on a wood stool and a tray, were the work of the co-editor of this Supplement, Mr. H. J. Potter.

Mr. W. L. Shears brought along a small showcase illustrating the process of making an artificial eye, together with unusual photographs of a tortoise and an artificial leg made by himself. Mr. Robert Foale, London branch secretary for many years, showed photographs and watercolours of excellent quality. The embroidered cushion covers hanging at the left front of the table, which claimed repeated admiring comments from the many ladies present, were the work of J. R. Pears.

At the extreme left of the picture may be seen the tall stand made by E. M. Natt to provide illumination for his many coloured transparencies of dental and general outside subjects, while his pottery and black and

white photography were continually being examined. A replica of an eye in its socket, and a complete finger in plastic were indications of the perfection which Mr. Gower has attained in the use of polyvinyl chloride.

There are some aspects of our members' outside interests which it is not possible to display, or which are not suitable to refer to at such an exhibition, but a knowledge of their activities beyond technical and artistic

Mr. F. E. Martin in charge of the London branch table which had been arranged by Mrs. Martin.

Specimens of cast-gold skeleton work by Messrs. Fordham and Emmett, Glenross screws in orthodontic appliances by Mr. E. G. Bell, an instructive selection of various types of wrought-wire clasps by L. Heydermann, and the exquisite oil painting by national president Eric G. Emmett, all demonstrated the vitality of S.I.M.A. members, not only in industry, but also in the arts.

achievements is always conducive to mutual respect and understanding. Mr. Martin is running as a Conservative candidate for the Walham Ward of Fulham Borough Council. He is also visiting Oslo in July, and has arranged to meet a number of Norwegian dental laboratory owners: we look forward to receiving an interesting account of the professional conditions in Norway and Sweden.

# NEWS FROM HEAD OFFICE

*N.J.C. Constitution.*—The revised constitution of the National Joint Council for the Craft of Dental Technicians has been referred to the constituent bodies for approval and will be considered at the next Main Committee Meeting.

*N.J.C. Apprenticeship Indenture.*—The Joint Secretaries of the N.J.C. have been asked to consider what amendments are necessary to the model indenture and to report back to the Joint Council.

*Termination of Indentures.*—Several cases concerning the dismissal of apprentices have recently been referred to the N.J.C. Disputes Committee and members who may be in difficulties owing to the present economic circumstances are again urged to consult the Association before taking any decisive step

in regard to the termination of their apprentices' indentures.

*Chairman's Visits to the Provinces.*—The Chairman, Mr. E. G. Emmett, will be pleased to visit during the next few months any branches or centres where a sufficient number of laboratory owners can be gathered together. Branch secretaries and members desiring such a visit are asked to communicate with Mr. Emmett as early as possible.

*Advanced Dental Technology.*—A scheme for the award of certificates in specialized branches of advanced dental technology has been adopted by the City and Guilds of London Institute on the recommendation of its advisory Committee and has been approved by the National Joint Council for the Craft of Dental Technicians. It is designed for those who hold a Final Certificate and wish to specialize in one of the following branches:—

I. Orthodontic work.

II. Dental ceramics and crown and bridge work.

III. Maxillo-facial work.

An examination in each of the three branches will be offered once a year as from 1955 and will comprise a written paper and a practical test, which will include *viva voce* questions by the examiners.

Further particulars may be obtained from Head Office.

*South African Regulations for Dental Technicians.*—The National Joint Council has received an inquiry from the Dental Technicians Board asking whether arrangements could be made to examine in this country technicians who wished to emigrate to South Africa. The matter will be considered further by the Council on receipt of particulars of the standard of the examination which the Board have in mind, and a copy of the syllabus for any examination conducted by them in South Africa. We have on file at the S.I.M.A. office, copies of the South African Act and Regulations relating to dental technicians which may be inspected by any member interested.

*Affiliated Members.*—We invite all affiliated members whose laboratories have been established for five years, to apply for full membership which will entitle them to full voting powers and thus enable them to participate in the formulation of the Association's policy.

*S.I.M.A. Annual General Meeting and Dinner and Dance.*—The Annual Dinner and Dance will take place at the Trocadero Restaurant, London, on Friday, Oct. 9, preceded by the Annual General Meeting at 6 Holborn Viaduct, commencing at 1.30 p.m. Members are asked to reserve the date.

*Change of Address.*—Mr. R. B. Wilson has moved to the following address: 36 West Princes Street, Glasgow, C.4.

### EXHIBITION OF PROSTHETIC MATERIALS AND WORKMANSHIP AT PALAIS D'ORSAY, PARIS, MAY 16

THE French laboratory men are anxious that the public should know of the value of the dental laboratories to the dental profession; routine work, special work, and novelties are to be shown. A small party will be taking samples of British work, and those who wish to attend, or are willing to lend their work for display, are asked to contact Mr. Beauchamp at once.

The next day will be spent considering a proposed draft of by-laws of the International Federation of Dental Prosthetists created at Nice last summer.

## BRANCH NEWS

**Northern Branch.**—At the last meeting of the North-western Branch, a message was read from the Liverpool Branch expressing willingness to amalgamate with the North-eastern and our own branch. The proposal was accepted, and Northern Branch S.I.M.A. was the name chosen by the members concerned.

To celebrate the union an all-day conference is being arranged to take place at the Harris Institute Art School, Preston, on Saturday, June 13. Commencing at 10.30 a.m., the day will be occupied by business meeting, table demonstrations, talks and lecture, and will end at 5.30 p.m.

London men are supporting with a table full of workmanship, and it is hoped that Preston may become a northern centre for such cultural efforts.